

CLAIMS

What is claimed is:

1. A method for performing noise reduction on a video stream having a plurality of fields, the method comprising:
 - storing a first field having a plurality of pixels in a first field buffer;
 - storing a second field having a plurality of pixels in a second field buffer;
 - modifying a subset of pixels of the second field using information from the first field;
 - storing the subset of the pixels of the second field in the second buffer;
 - storing a third field having a plurality of pixels in the first field buffer;
 - modifying a subset of pixels of the third field using information from the second field; and
 - storing the subset of pixels of the third field in the first buffer.
2. The method of Claim 1, further comprising:
 - storing a fourth field having a plurality of pixels in the second field buffer;
 - modifying a subset of pixels of the fourth field using information from the third field; and
 - storing the subset of pixels of the fourth field in the second buffer.
3. The method of Claim 1, wherein the modifying a subset of pixels of the second field using information from the first field comprises:
 - selecting the subset of pixels using still pixel detection; and

modifying each pixel of the subset of pixels using a corresponding pixel of the first field.

4. The method of Claim 3, wherein the selecting the subset of pixels using still pixel detection further comprises:

determining whether each pixel of the second field is a still pixel; and

adaptively updating a still pixel threshold parameter.

5. The method of Claim 1, wherein the modifying a subset of pixels of the second field using information from the first field further comprises:

determining whether each pixel of the second field is a luminance still pixel; and

modifying a luminance value of a pixel in the second field when the pixel is a luminance still pixel.

6. The method of Claim 5, wherein the determining whether each pixel of the second field is a luminance still pixel comprises:

calculating a luminance motion parameter for each pixel;

classifying a pixel as a luminance still pixel when an absolute value of the luminance motion parameter of the pixel is less than or equal to a luminance threshold.

7. The method of Claim 6, further comprising adaptively updating the luminance threshold.

8. The method of Claim 5, wherein the determining whether each pixel of the second field is a luminance still pixel comprises:

defining a first window containing a first plurality of pixels of the second field, wherein the first plurality of pixels includes a current pixel;

performing a first window still pixel test using the pixels of the first window.

9. The method of Claim 8, wherein performing a first window still pixel test using the pixels of the first window comprises:

calculating a pixel pair difference for each pixel in the first window to generate a plurality of pixel pair differences; and

comparing an absolute value of each pixel pair difference with a difference threshold, wherein the current pixel fails the first window still pixel test when the absolute value of any pixel pair difference of the first window is greater than the difference threshold.

10. The method of Claim 9, wherein performing a first window still pixel test using the pixels of the first window comprises:

summing the absolute value of each pixel pair difference that is greater than a summation threshold to create a correlation sum of the first window;

comparing the correlation sum of the first window with a correlation threshold, wherein the current pixel passes the first still pixel test when the correlation sum divided by a size of the first window is less than or equal to the correlation threshold.

11. The method of Claim 10, further comprising adaptively updating the correlation threshold.

12. The method of Claim 8, wherein the determining whether each pixel of the second field is a luminance still pixel, further comprises:

defining a second window containing a second plurality of pixels of the second field, wherein the second plurality of pixels includes the current pixel;

performing a second window still pixel test using the pixels of the second window.

13. The method of Claim 12, wherein a pixel is a luminance still pixel when the pixel passes the first window still pixel test or the second window still pixel test.

14. The method of Claim 5, wherein the modifying the luminance value of a pixel in the second field when the pixel is a luminance still pixel, comprises setting the luminance value of the pixel in the second field to be equal to a luminance value of a corresponding pixel in the first field plus a luminance noise reduction level parameter multiplied by a luminance motion parameter.

15. The method of Claim 14, wherein the luminance motion parameter is equal to a luminance value of a current pixel in the second field minus the luminance value of a corresponding pixel in the first field.

16. The method of Claim 5, wherein the modifying a subset of pixels of the second field using information from the first field further comprises:

incrementing a luminance still pixel counter parameter by 1 when a pixel is classified as a luminance still pixel;

increasing a luminance difference summation parameter by a square of the luminance motion parameter when a pixel is classified as a luminance still pixel.

17. The method of Claim 16, wherein the modifying a subset of pixels of the second field using information from the first field further comprises:

determining whether each pixel of the second field is a chrominance still pixel; and

modifying a first chrominance value of a pixel in the second field when the pixel is a chrominance still pixel.

18. The method of Claim 17, wherein the modifying a subset of pixels of the second field using information from the first field further comprises modifying a second chrominance value of a pixel in the second field when the pixel is a chrominance still pixel.

19. A method for performing noise reduction on a video stream having a plurality of fields including an early field and a late field, the method comprising:

determining whether a late current pixel of the late field is a luminance still pixel;

modifying a luminance value of the late current pixel when the late current pixel is a luminance still pixel;

determining whether the late current pixel is a chrominance still pixel;

modifying a first chrominance value of the late current pixel when the late current pixel is a chrominance still pixel.

20. The method of Claim 19, wherein the determining whether the late current pixel is a chrominance still pixel further comprises:

determining whether the late current pixel is a U chrominance still pixel; and

determining whether the late current pixel is a V chrominance still pixel.

21. The method of Claim 20, wherein the modifying a first chrominance value of the late current pixel when the late current pixel is a chrominance still pixel is performed only when the late current pixel is a U chrominance still pixel and a V chrominance still pixel.

22. The method of Claim 20, further comprising modifying a second chrominance value of the late current pixel when the late current pixel is a chrominance still pixel.

23. The method of Claim 19, wherein the determining whether the late current pixel is a chrominance still pixel is performed only when the late current pixel is a luminance still pixel.

24. The method of Claim 19, wherein the determining whether a late current pixel of the late field is a luminance still pixel comprises:

calculating a luminance motion parameter for the late current pixel;

classifying the late current pixel as a luminance still pixel when an absolute value of the luminance motion parameter of the late current pixel is less than or equal to a luminance threshold.

25. The method of Claim 24, further comprising adaptively updating the luminance threshold.

26. The method of Claim 19, determining whether a late current pixel of the late field is a luminance still pixel comprises:

defining a first window containing a first plurality of pixels of the late field, wherein the first plurality of pixels includes the late current pixel;

performing a first window still pixel test using the pixels of the first window.

27. The method of Claim 26, wherein performing a first window still pixel test using the pixels of the first window comprises:

calculating a pixel pair difference for each pixel in the first window to generate a plurality of pixel pair differences; and

comparing an absolute value of each pixel pair difference with a difference threshold, wherein the current pixel fails the first window still pixel test when the absolute value of any pixel pair difference of the first window is greater than the difference threshold.

28. The method of Claim 27, wherein performing a first window still pixel test using the pixels of the first window comprises:

summing the absolute value of each pixel pair difference that is greater than a summation threshold to create a correlation sum of the first window;

comparing the correlation sum of the first window with a correlation threshold, wherein the current pixel passes the

first window still pixel test when the correlation sum divided by a size of the first window is less than or equal to the correlation threshold.

29. The method of Claim 28, further comprising adaptively updating the correlation threshold.

30. The method of Claim 26, wherein determining whether a late current pixel of the late field is a luminance still pixel further comprises:

defining a second window containing a second plurality of pixels of the second field, wherein the second plurality of pixels includes the late current pixel;

performing a second window still pixel test using the pixels of the second window.

31. The method of Claim 30, wherein a pixel is a luminance still pixel when the pixel passes the first window still pixel test or the second window still pixel test.

32. The method of Claim 19, wherein modifying a luminance value of the late current pixel when the late current pixel is a luminance still pixel, comprises setting the luminance value of the late current pixel in the late field to be equal to a luminance value of a corresponding early current pixel in the early field plus a luminance noise reduction level parameter multiplied by a luminance motion parameter.

33. The method of Claim 32, wherein the luminance motion parameter is equal to a luminance value of the late current pixel in the late field minus the luminance value of the early current pixel in the early field.

34. The method of Claim 19, wherein the modifying a luminance value of the late current pixel when the late current pixel is a luminance still pixel further comprises:

incrementing a luminance still pixel counter parameter by 1 when the late current pixel is classified as a luminance still pixel;

increasing a luminance difference summation parameter by a square of the luminance motion parameter when the late current pixel is classified as a luminance still pixel.

35. The method of Claim 19, wherein the determining whether a late current pixel of the late field is a chrominance still pixel comprises:

calculating a first chrominance motion parameter for the late current pixel;

calculating a second chrominance motion parameter for the late current pixel;

classifying the late current pixel as a chrominance still pixel when an absolute value of the first chrominance motion parameter of the late current pixel is less than or equal to a chrominance threshold, and an absolute value of the second chrominance motion parameter of the late current pixel is less than or equal to the chrominance threshold.

36. The method of Claim 35, further comprising adaptively updating the chrominance threshold.

37. The method of Claim 19, wherein modifying a first chrominance value of the late current pixel when the late current pixel is a chrominance still pixel, comprises setting the first chrominance value of the late current pixel in the late field to

be equal to a first chrominance value of a corresponding early current pixel in the early field plus a chrominance noise reduction level parameter multiplied by a first chrominance motion parameter.

38. The method of Claim 37, wherein the first chrominance motion parameter is equal to a first chrominance value of the late current pixel in the late field minus the first chrominance value of the early current pixel in the early field.

39. The method of Claim 19, wherein modifying a first chrominance value of the late current pixel when the late current pixel is a chrominance still pixel further comprises:

incrementing a chrominance still pixel counter parameter by 1 when the late current pixel is classified as a chrominance still pixel;

increasing a chrominance difference summation parameter by a square of the chrominance motion parameter when the late current pixel is classified as a chrominance still pixel.

40. The method of Claim 19, further comprising modifying a second chrominance value of the late current pixel when the late current pixel is a chrominance still pixel.

41. The method of Claim 40, wherein modifying a second chrominance value of the late current pixel when the late current pixel is a chrominance still pixel, comprises setting the second chrominance value of the late current pixel in the late field to be equal to a second chrominance value of a corresponding early current pixel in the early field plus a chrominance noise reduction level parameter multiplied by a second chrominance motion parameter.

42. The method of Claim 41, wherein the second chrominance motion parameter is equal to a second chrominance value of the late current pixel in the late field minus the second chrominance value of the early current pixel in the early field.

43. The method of Claim 40, wherein modifying a second chrominance value of the late current pixel when the late current pixel is a chrominance still pixel further comprises:

- incrementing a chrominance still pixel counter parameter by 1 when the late current pixel is classified as a chrominance still pixel;

- increasing a chrominance difference summation parameter by a square of the chrominance motion parameter when the late current pixel is classified as a chrominance still pixel.

44. A system for performing noise reduction on a video stream having a plurality of fields, the system comprising:

- means for storing a first field having a plurality of pixels in a first field buffer;

- means for storing a second field having a plurality of pixels in a second field buffer;

- means for modifying a subset of pixels of the second field using information from the first field;

- means for storing the subset of the pixels of the second field in the second buffer;

- means for storing a third field having a plurality of pixels in the first field buffer;

- means for modifying a subset of pixels of the third field using information from the second field; and

- means for storing the subset of pixels of the third field in the first buffer.

45. The system of Claim 44, further comprising:

means for storing a fourth field having a plurality of pixels in the second field buffer;

means for modifying a subset of pixels of the fourth field using information from the third field; and

means for storing the subset of pixels of the fourth field in the second buffer.

46. The system of Claim 44, wherein the means for modifying a subset of pixels of the second field using information from the first field comprises:

means for selecting the subset of pixels using still pixel detection; and

means for modifying each pixel of the subset of pixels using a corresponding pixel of the first field.

47. The system of Claim 46, wherein the means for selecting the subset of pixels using still pixel detection further comprises:

means for determining whether each pixel of the second field is a still pixel; and

means for adaptively updating a still pixel threshold parameter.

48. The system of Claim 44, wherein the means for modifying a subset of pixels of the second field using information from the first field further comprises:

means for determining whether each pixel of the second field is a luminance still pixel; and

means for modifying a luminance value of a pixel in the second field when the pixel is a luminance still pixel.

49. The system of Claim 48, wherein the means for determining whether each pixel of the second field is a luminance still pixel comprises:

means for calculating a luminance motion parameter for each pixel;

means for classifying a pixel as a luminance still pixel when an absolute value of the luminance motion parameter of the pixel is less than or equal to a luminance threshold.

50. The system of Claim 49, further comprising means for adaptively updating the luminance threshold.

51. The system of Claim 49, wherein means for the determining whether each pixel of the second field is a luminance still pixel comprises:

means for defining a first window containing a first plurality of pixels of the second field, wherein the first plurality of pixels includes a current pixel;

means for performing a first window still pixel test using the pixels of the first window.

52. The system of Claim 51, wherein the means for performing a first window still pixel test using the pixels of the first window comprises:

means for calculating a pixel pair difference for each pixel in the first window to generate a plurality of pixel pair differences; and

means for comparing an absolute value of each pixel pair difference with a difference threshold, wherein the current pixel fails the first window still pixel test when the

absolute value of any pixel pair difference of the first window is greater than the difference threshold.

53. A system for performing noise reduction on a video stream having a plurality of fields including an early field and a late field, the system comprising:

- means for determining whether a late current pixel of the late field is a luminance still pixel;

- means for modifying a luminance value of the late current pixel when the late current pixel is a luminance still pixel;

- means for determining whether the late current pixel is a chrominance still pixel;

- means for modifying a first chrominance value of the late current pixel when the late current pixel is a chrominance still pixel.

54. The system of Claim 53, wherein the means for determining whether the late current pixel is a chrominance still pixel further comprises:

- means for determining whether the late current pixel is a U chrominance still pixel; and

- means for determining whether the late current pixel is a V chrominance still pixel.

55. The system of Claim 54, wherein the means for modifying a first chrominance value of the late current pixel when the late current pixel is a chrominance still pixel is used only when the late current pixel is a U chrominance still pixel and a V chrominance still pixel.

56. The system of Claim 54, further comprising means for modifying a second chrominance value of the late current pixel when the late current pixel is a chrominance still pixel.

57. The system of Claim 53, wherein the means for determining whether the late current pixel is a chrominance still pixel is used only when the late current pixel is a luminance still pixel.

58. The system of Claim 53, wherein the means for determining whether a late current pixel of the late field is a luminance still pixel comprises:

means for calculating a luminance motion parameter for the late current pixel;

means for classifying the late current pixel as a luminance still pixel when an absolute value of the luminance motion parameter of the late current pixel is less than or equal to a luminance threshold.

59. The system of Claim 48, further comprising means for adaptively updating the luminance threshold.